IoT Based Smart Irrigation System

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Article Info
Page Number: 8640-8648
Publication Issue:
Vol. 71 No. 4 (2022)

Article History
Article Received: 15 September 2022
Revised: 25 October 2022
Accepted: 14 November 2022
Publication: 21 December 2022

Abstract: - A large amount of water is needed for agricultural purposes, and this is prominent. Water demand has been insufficient to meet expectations. Crop growth and water consumption are both reduced in proportion to the degree to which irrigation needs are not met. A fully automated system is required. This paper is concerned with assisting crops in meeting their water requirements by monitoring soil moisture and other environmental factors. A proposal for an irrigation system was made for this field; the primary goal of this paper is to meet the water needs of cultivated plants. Sensor data is sent to the cloud, where farmers can access and manage it remotely using their smartphones. The device includes a wireless sensor unit, an Arduino microcontroller, and a WiFi module with pump control and relay connectivity via a relay. The automatic irrigation system, which reduces wasteful water use in farming, is subject to this observation.

Keywords— Android Application, Arduino, Internet of Things, WiFi module, Relay.

I.INTRODUCTION

Water shortage is the world's most significant downside in the current age. Agriculture is a family profession associated with an abundance of water. Irrigation is the application of water to crops to replenish rainfall. Irrigation system implementation varies. Irrigation system efficiency is not discernible. This crop also depends on the soil, crop, and environmental parameters like temperature and wetness when determining its water demand.

On the other hand, typical irrigation systems finish in either under or over-irrigated land. When a plant does not get enough water, it prevents the growth and development of plants. Likewise, excessive water harms plant growth. The irrigated farmland typically has an underlying irrigation system, which may be in various places, including within the irrigated fields, under or over the irrigated fields, or anywhere else in between. A space with more water than usual can suffer from poor plant health because of increased salinity. When water replaces air in the soil's pores, it limits the growth of grass and roots. As a result, the roots of the plants are not adequately supplied with oxygen. It should help nature function typically. Irrigated space, on the other hand, faces water stress underneath. So, the role of economic water management in agriculture is essential.

In traditional irrigation, human effort and time-intensive are required. Net of Things is now capable of handling irrigating systems with sensible resolution. IoT, which includes things like sensors, vehicle intercommunication systems, and things we will find in a house like doorbells, ovens, and lightbulbs, refers to a broad, ever-growing network of physical objects, each of which has an information science address associated with the net property, and the communication that happens between these objects and other Internet-enabled devices and systems. Wireless sensor networks (WSN)[1] have garnered increased attention in the academic and commercial spheres in recent years, and they are deployed in numerous application areas. WSN has been showcased in the context of today's most impressive and advanced emerging technologies that can link the physical and virtual worlds[2], allowing them to interact. A WSN comprises a wide range of sensor nodes, commonly deployed in an expansive geographic area to monitor specific features. The full complement of detectors are called nodes and are small, purpose-built electronic devices with a pre-assigned set of simple calculations and sending and receiving information. Included onboard sensors collect information from the surrounding atmosphere, all of which is sent to a central database. From tracking individuals to environment pollution to accuracy agriculture, WSNs are employed in every military and civilian application. Because the planned irrigation system is driven by soil wetness, environmental temperature, and wetness, it is economical in its management of water. This machine-driven system reduces farmers' involvement in farming, increases crop yield, shortens the process, and offers time-saving tools for remote monitoring.

The remaining paper is organized as section II describes the related work, section III presents the system model, Section IV presents the system specifications, Section V presents the working model. Section VI presents the Result, and Section VII concludes the paper.

II.RELATED WORK

The automated irrigation sensor designed by Joaquin Gutierrez Jaguey et al. [3] has been built. The sensor is built around a smartphone and uses to capture and process digital images of the soil around the crop's root zone, then estimates the water content of the soil using image processing. The sensor is kept in a sealed chamber and planted at the root level to obtain accurate readings.

Recent evidence points to rising temperatures and droughts, resulting in more enormous wildfires that endanger both the environment and human lives and beings. Better wildfire prediction tools must be developed in this context. Using remotely sensed soil moisture data, Joaquín Gutiérrez et al. [4] explored the wildfire-climate relationship in this paper using remotely sensed soil moisture data. The investigation is focused on fires in the Iberian Peninsula that were registered between 2010 and 2014. SMOS soil moisture data and ERA-Interim land surface temperature reanalysis were used to investigate the prior-to-occurrence surface moisture temperature conditions.

G.nisha et al. [5] developed an automated irrigation system to help crops maximize water use. The wireless soil moisture and temperature sensors are scattered throughout the root zone of the plants, distributed over the system. Additionally, a gateway unit handles sensor information and acts as an intermediary for triggers and actuators. It also forwards sensor data to a web application. To control water quantity, an algorithm was developed using temperature and soil moisture thresholds and programmed into a microcontroller-based gateway. The photovoltaic power system was backed up by the panels, which also had a duplex communication link. This communication link is made possible using a cellular-Internet interface, which makes it possible to configure data inspection and irrigation scheduling through a web page.

Automatic water use optimization by Aravind Anil et al.[6] is accomplished through a wireless sensor network. This system features distributed wireless sensor networks placed throughout the crop field that measure soil moisture and temperature. Zigbee protocol was used to handle sensor information and program the irrigation system's water quantity using an algorithm that utilizes sensor thresholds and a microcontroller. To ensure system availability, a solar panel and a cellular internet connection interface have been implemented. A wireless camera is placed in a crop field to use image processing techniques to monitor the disease area. The system is inexpensive and offers water independence in regions with limited water supply.

III.SYSTEM MODEL

Our system is consisting the two modules: the transmitter and the coordinator. Misting soil sensor and temperature-humidity sensor, as shown in Fig. 1, are joined with the microcontroller to form a transmitter module. The ESP8266, connected to the web via a microcontroller, is acting as a WiFi module. An IoT (Internet of Things) application is built in Blynk[7], and this is an open supply application. Associated API key, which is used to send sensing element information to the cloud and store it in the created channel and fixed fields, is made available through Blynk. Using the Hypertext Transfer Protocol (HTTP), the microcontroller collects the sensing element values and sends them to the Blynk cloud[8].

Module in Fig. 2 gets the command from the Android app and transmits it to the device via the internet. It is made up of a microcontroller-equipped relay, which manages the motor, and a WiFi module hooked up to the network.

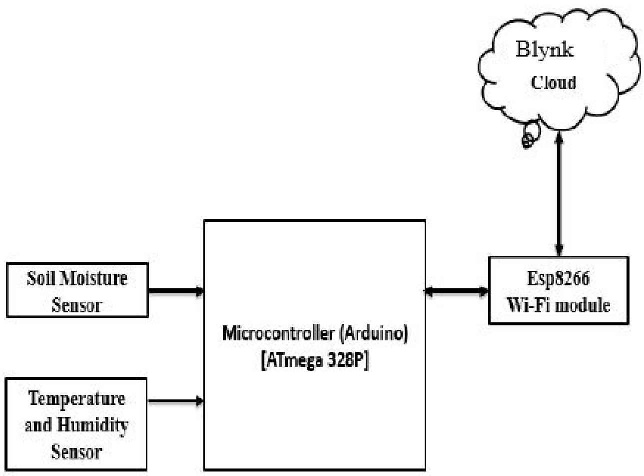

Fig. 1. Transmitter Module

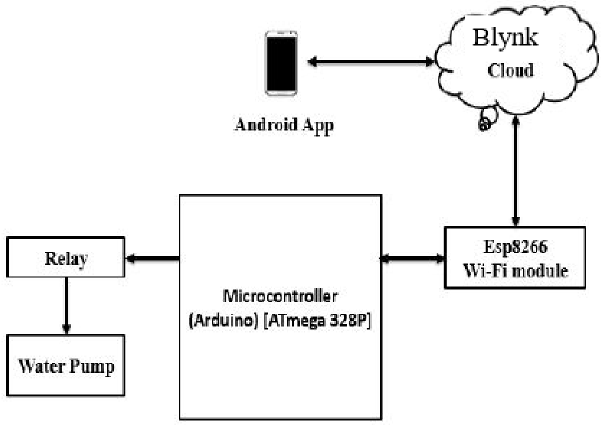

Fig. 2. Coordinator Module

IV.SYSTEM SPECIFICATION

A. Arduino Uno

An open-source, easy-to-use electronics prototyping platform based on flexible and powerful hardware and user-friendly software called Arduino. Fig. 3 depicts the Arduino Uno, which can sense its environment through sensors and can affect it by controlling various lights, motors, and other actuators. An Arduino board consists of an Atmel 8-bit AVR[9] microcontroller with complementary components to make programming more straightforward to integrate into other projects. When compared to other devices, using an external programmer to upload new programs to the on-chip memory is much simpler when using an Arduino microcontroller with a boot loader pre-installed. The Arduino[10] Uno is a microcontroller board based on the ATmega328 microcontroller. It features a USB connection, a power jack, an ICSP header, six analog inputs, a 16 MHz ceramic resonator, and a reset button. All the required components are included, allowing us to get started with the microcontroller by connecting it to a computer with a USB cable or powering it with an AC-to-DC adapter or battery.

Fig. 3. Arduino Uno

B. YL-69 Soil Moisture Sensor

When used, the YL-69 wetness detector, or the measuring instrument in Fig. 4, generally determines the moisture level in the soil. Watching our plants' soil wetness can be a helpful method of knowing if we should apply automatic watering systems. The board is missing two pieces: the probe, which detects water content, and the electronic circuit board. A built-in potentiometer can be used to adjust the output sensitivity of the digital output, along with a power LED and a digital output LED. Once the soil is dry, the sensor's voltage will be high; as the soil gets wet, the voltage of the sensor will go down.

C. DHT11 Temperature Humidity Sensor

In Figure 5, there is a digital temperature and moisture detector as part of the DHT11. It has a high level of reliability and constant stability thanks to its technology.

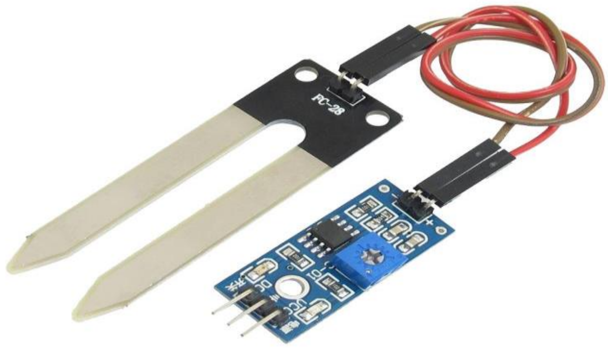

Fig. 4. YL-69 Soil Moisture Sensor

This detector includes a resistive element and a method of NTC temperature measurement devices, as well as a wet resistive element. The positive attributes of high-quality, fast response, anti-interference capability, and an affordable price combine to make this a desirable option. To measure relative humidity, use a humidity sensor with two electrodes separated by a wet substrate. This, therefore, shows that as the humidity changes, the physical phenomenon of the substrate (i.e., the substrate's physical properties) also changes, or in other words, the physical relationship between these electrodes' resistance changes. A significant change has occurred in the resistance that has been measured and handled by the Integrated Chip, which is now capable of being scanned by a microcontroller. These sensors utilize an NTC temperature detector or a semiconductor unit for mensuration temperature. Rheostats, which are also known as thermistors, change their resistance with a temperature change. To create these sensors, ceramic or polymer materials are sintered to supply more significant resistance changes with more minor temperature changes. To say that the resistance decreases with an increase in temperature is referred to as the "NTC"[11], which implies that the term is saying that the coefficient of resistance (or term voltage) decreases with increasing temperature.

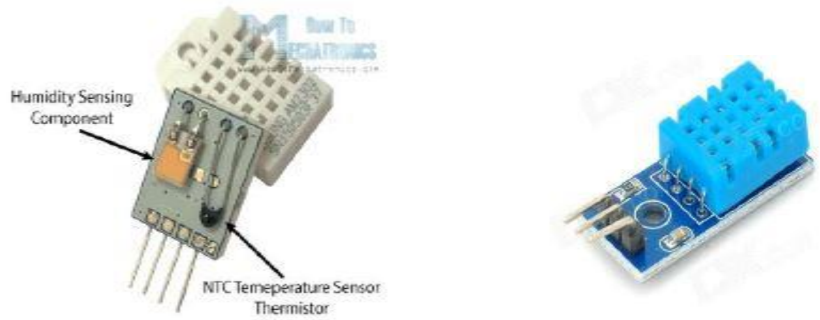

Fig. 5. DHT11 Temperature Humidity Sensor

D. Esp8266 WiFi Module

ESP8266 represents an entire and self-contained WiFi networking solution. It may either host the application or, by dumping all WiFi networking tasks, free the main CPU to dedicate itself to running additional applications. Once ESP8266 serves as the primary application processor, the device can boot directly from external flash memory. It is an integrated cache to help the system run faster in applications where such a performance boost is essential and to help with memory requirements. Either serving as a WiFi adapter or providing wireless web access is optional for microcontroller-based designs. They either utilize UART or the CPU AHB[12] bridge interface for communication. The onboard processing and storage capabilities of the ESP8266 enable it to be integrated with sensors and other alternative application-specific devices, such as potentiometers, using its GPIOs. As a result, ESP8266 devices can be developed in tandem with their integration, thus speeding up project creation and reducing overall runtime consumption. Due to the extreme amount of integration on the chip, power management converters, and the fact that the entire solution, including the front-end module, is meant to use space on a token-based PCB, the solution plus the front-end module both occupy a token-based PCB. The features of primary importance are

- 802.11 b/g/n protocol
- WiFi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack

Fig. 6. Esp8266 WiFi Module ESP-01

V.WORKING MODEL

The transmitter module's microcontroller checks for the soil's wetness and environmental factors like temperature and humidity. Every five seconds, those values are sent to the cloud through the net. Logged knowledge is envisioned as graphs in the Blynk cloud[14]. An alert message is sent to the farmer when the sensor values exceed the brink. Farmers with this Creative Permit can display a water motor on the water using an electronic relay connected to an arrangement module through a wire. If the desired environmental conditions are met, an alert is issued to the farmer to be sure the motor is operating correctly.

Fig. 7. Working Prototype

VI.RESULT

See Figure 7 for an example of a sensible irrigation system. We perform experiments on the potato plant to ensure the system's dependability. Each day, the potato plant requires 500-700mm of water. The analytics on the cloud is set to soil wet to have a varying level of soil wetness in the range of 300-600. It was discovered that the system works as intended, and water is appropriately tense to the sphere when and only when needed. An alert message is sent to the farmer if the soil is dry. As illustrated in the picture, the farmer activates the golem's motor by pressing the buttons in Fig 8. When the soil wetness requirement is met, the system automatically runs the motor and displays it on the mobile device. Fig. 8 images represent soil wetness, wetness, and temperature separately[13].

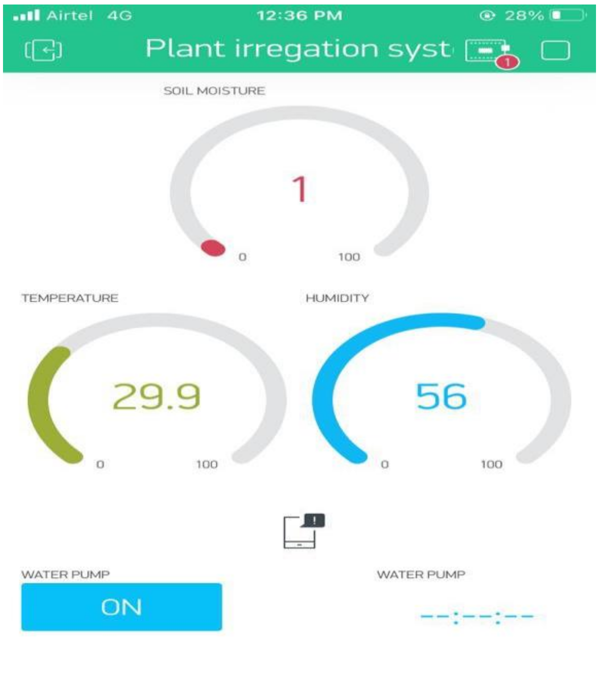

Figure 8. The output of the system

VII.CONCLUSION

The system's predicted infrastructure will allow for both cost-effective and reliable irrigation. It is simple to investigate and obtain knowledge about the information because we can rely on regular updates of the soil conditions and environmental factors to allow us to do so. In dry regions, the system will work with efficient water crops wherever there is insufficient rainfall while ensuring a higher yield. It does away with human involvement. It provides the farmer with the information they need to understand their crops and surroundings better, helps them operate the pump, and monitors the field.

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